Space Weather Technical Forecast

Issued on Saturday, 27 May 2023 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1/R2 radio blackouts likely. Active electron fluence.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate, with an M1.3 flare peaking at 26/2303UTC from AR3315. This region remains by far the largest and also most complex on the disc. Whilst the current delta spot looks to be fading, a new small delta may be forming. AR3314 also appears to have developed a delta spot. The remaining regions are either small and simple or are currently stable.
A CME observed leaving the south of the Sun on coronagraph imagery late on 26 May is still being assessed, but is considered unlikely to have a significant impact at Earth.

Solar Wind / Geomagnetic Activity: Solar winds observed at L1 by ACE and DSCOVR showed a declining High Speed Stream (HSS) from Coronal Hole 06. The wind speed has eased slightly and is currently slightly elevated just above 400 km/s. Density has been around or below average. Total interplanetary magnetic field strength is weak at 5 nT or below, with the north-south component also varying weakly. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet throughout.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV at GOES-16) has remained at background levels throughout. High energy electron flux (greater than 2MeV at GOES-16) has been at high levels throughout, peaking at 4080 pfu at 26/1510 UTC. The associated 24 hour fluence was Active (above 1e8 integrated pfu) with a rising trend, reaching 1.99e8 integrated pfu at 27/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Low to Moderate solar activity is forecast, mainly due to the configuration and development of AR3315, but with an increasing risk from AR3314 in the northwest quadrant. There is a slight chance of X-flares.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 25 May may arrive at Earth either 29 or 30 May, but confidence is low. Otherwise the high speed stream from coronal hole 06 is expected to ease through 27 and 28 May, with the high speed stream from coronal hole 07 then expected to connect on 29 or 30 May and could coincide with the possible CME arrival. Mainly Quiet with some Unsettled intervals possible throughout the period. A slight chance of G1/Minor Storms on 29 or 30 May.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. There is a slight chance of reaching the S1/Minor Storm threshold should any larger flares occur, mainly from AR3315. High energy electron flux (greater than 2MeV) is expected to be at mostly high levels during the period. The forecast CME arrivals and high speed stream connections could generate enough geomagnetic activity to disrupt this cycle, but with limited confidence. Electron fluence values are expected to remain above the Active (1e8 integrated pfu) threshold, but with decreasing confidence later in the period.

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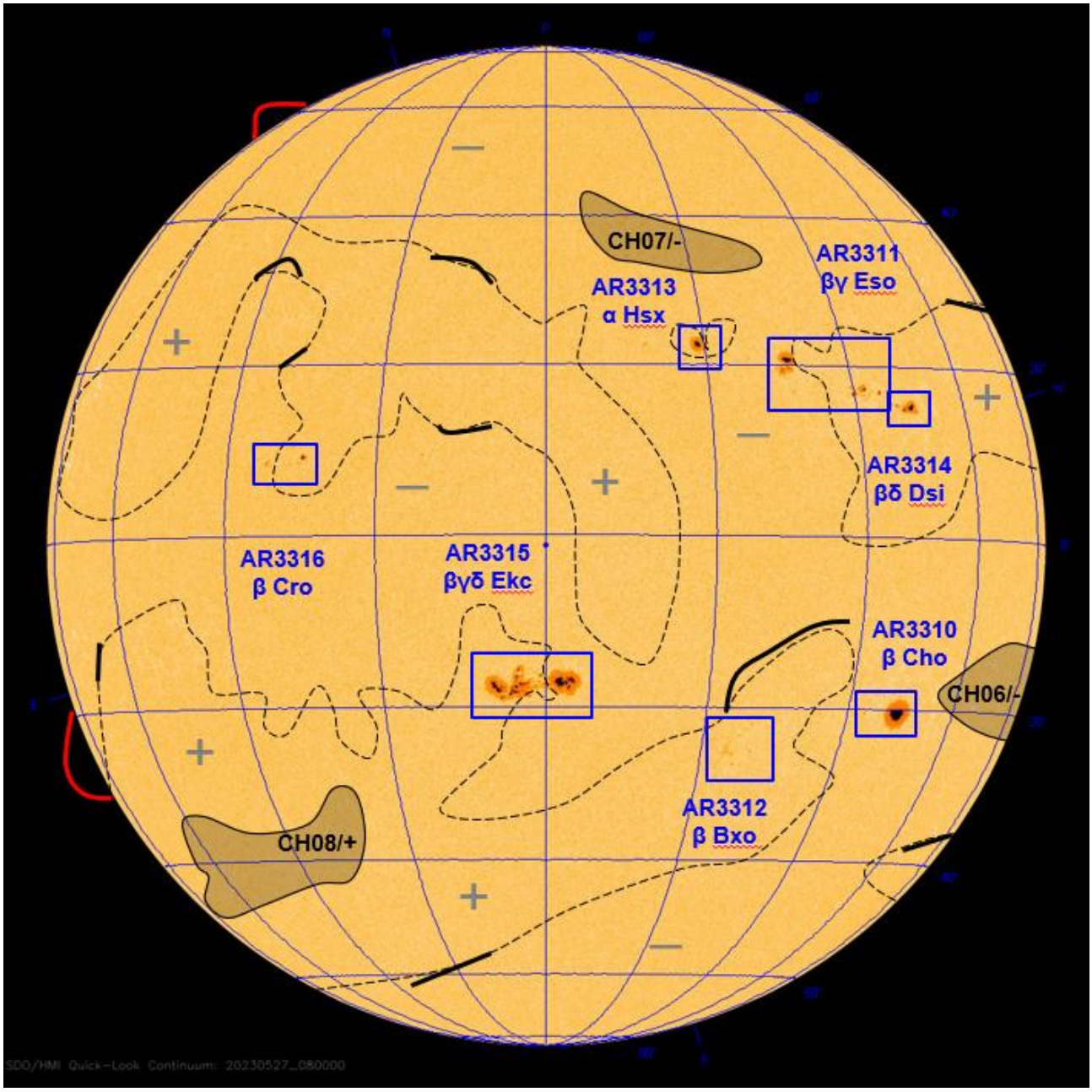
Figure 1. Solar Analysis Valid 27/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one possible CME in the forecast. An earlier CME which it was thought may give a glancing blow early on 27 May is now considered to have missed Earth. The potential Earth-directed CME still in the forecast left the Sun on 25 May and could arrive at Earth on 29 or 30 May, but with low confidence. No further Earth-directed CMEs have been identified with available imagery.

Otherwise Earth is under the influence of slightly elevated winds from the high speed stream of coronal hole 06 which is expected to continue to decline through the next 24 hours. The high speed stream from coronal hole 07 is then forecast to connect with Earth, although the northerly latitude of this feature makes the strength of any connection uncertain. Connection is forecast for either 28 or 29 May based on an estimated speed of 500km/s, but it may be that the tail of coronal hole 06 merges into the HSS from coronal hole 07.

Mainly Quiet geomagnetic activity is forecast throughout the period, with isolated Unsettled intervals. There is a slight chance of Active or G1/Minor Storm intervals on 29 May due to a possible combination of high speed stream connection and potential CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/0144	Partial	AR3312	S	347 km/s	29/2200 +/- 9 hours	Low confidence weak glancing impact

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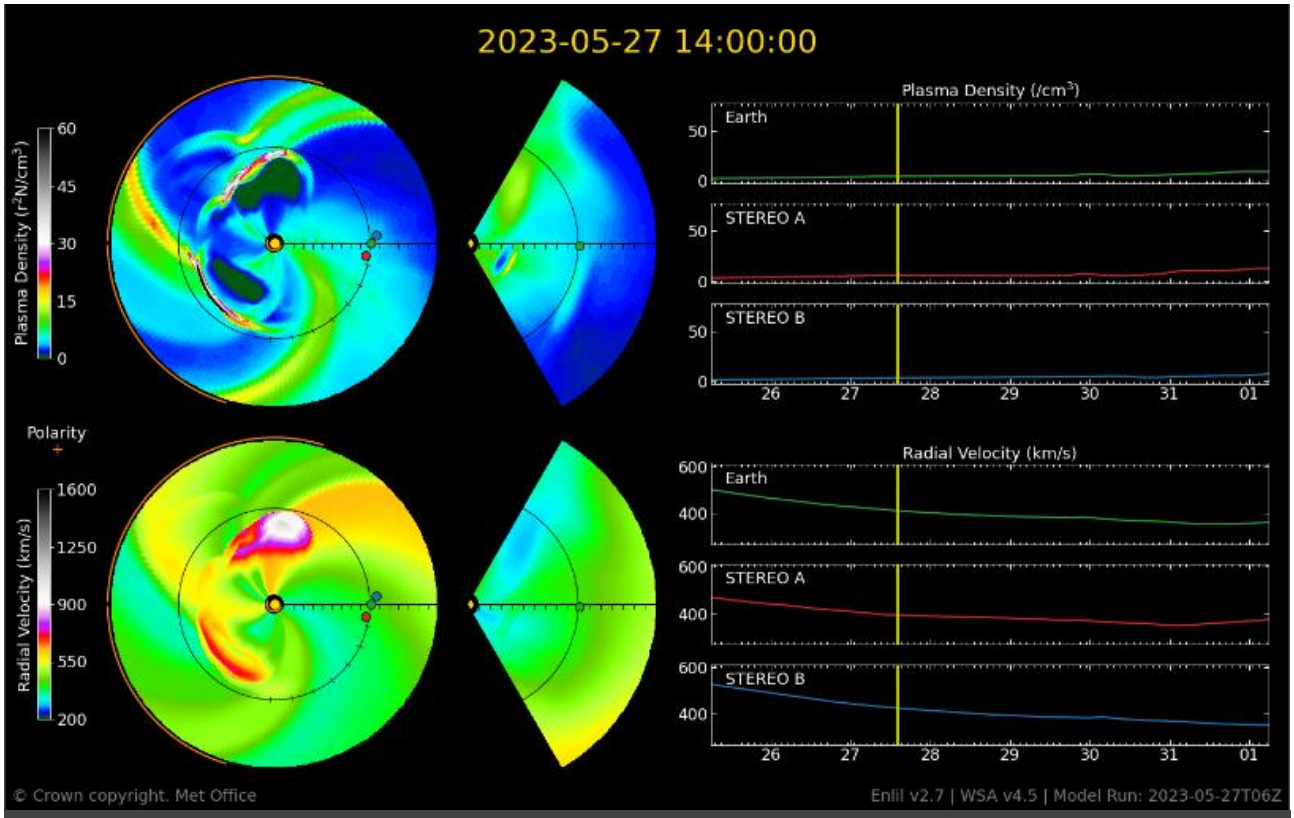
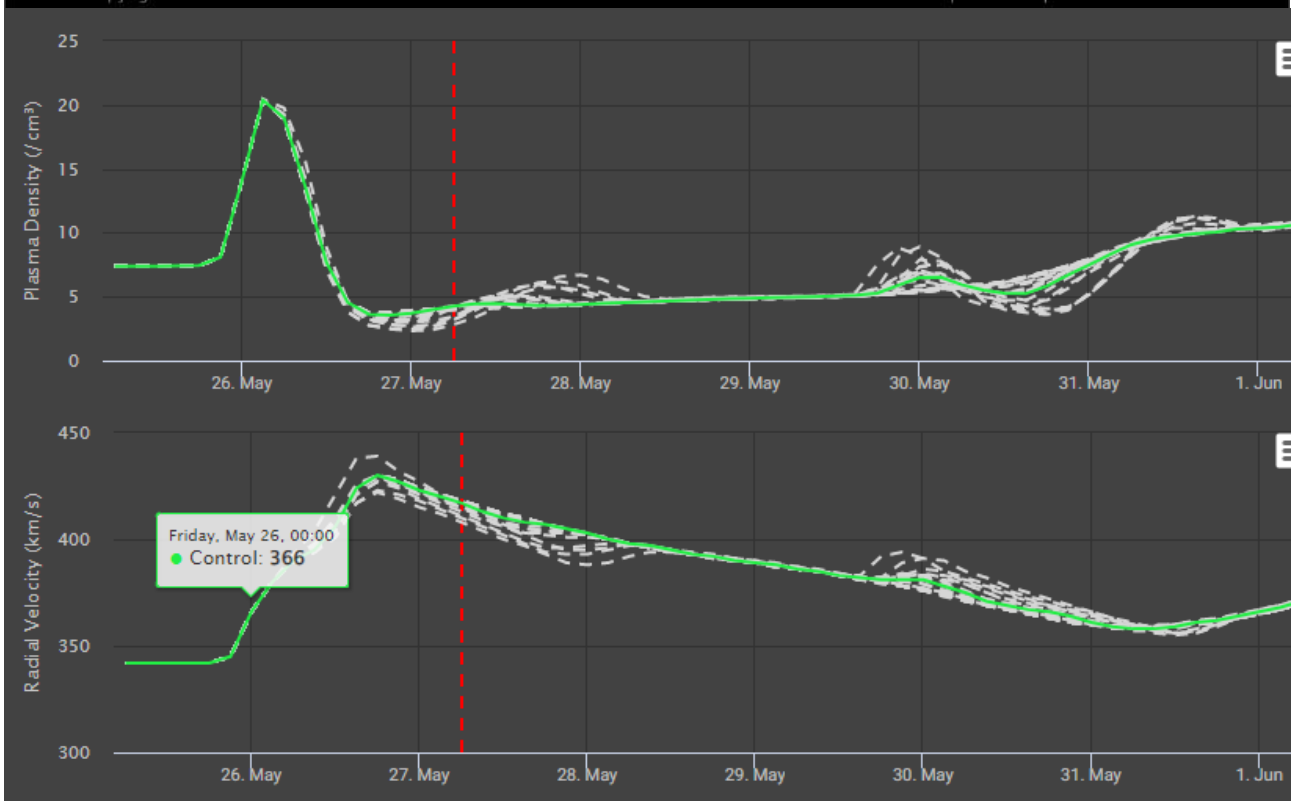
Figure 2: MOSWOC Enlil showing a gradual decline in wind speeds. This may not be taking account of the HSS from coronal hole 7. Also the ensemble, showing possible CME glancing blow from later on 29 May





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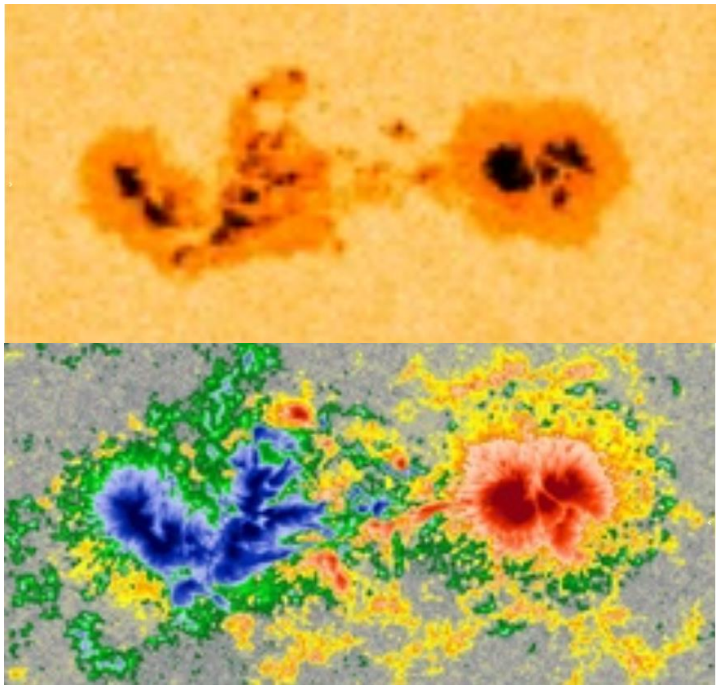
Radio Blackouts - X-Ray Flares:
Moderate to Low activity is forecast through the period, with a slight chance of X-class flares. AR3315 (Ekc/Beta-Gamma-Delta) is the most prominent and active region, which has been steadily growing. A persistent delta region is starting to fade, but there is another delta region which appears to be forming. AR3314 (Dsi/Beta-Delta) has developed, and now has a delta region within the penumbra of the main spot. This is the western end of a string of regions in the northwest with AR3313 and AR3311 both fairly simple, although AR3311 has recently re-developed a Beta-Gamma magnetic configuration. AR3312 in the southwest continues to weaken, with AR3310 also losing a number of spots to the north. AR3316 in the northeast appears weak and stable.

There are several potential regions to rotate onto the east limb in the coming days, but so far there is no significant over the limb activity. These regions will therefore be assessed for flare risk as they become visible.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: SDO intensitygram and magnetogram showing AR3315, with magnetic complexity in the centre of the sunspot region.



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at background levels and is currently expected to remain so throughout the period. There is a slight chance of an increase to the S1/Minor Storm level, should any larger flares occur, mainly from AR3315.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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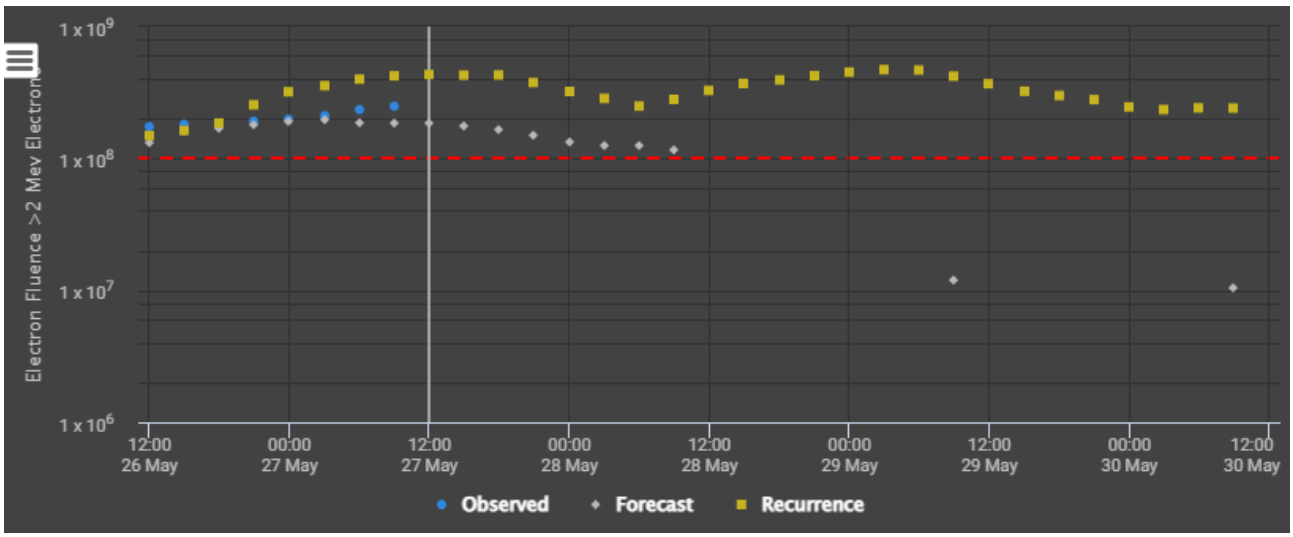
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) has been at high levels for the last 24 hours, with diurnal peaks over the last few days gradually increasing. This pattern is likely to continue through the period in the absence of any strong high speed streams or CME activity. The most likely source for any notable reduction is from the possible connection to the high speed stream from coronal hole 07, or a possible CME glancing blow, both of which are likely on 29 May.

Associated 24 hour fluence is expected to be above the Active threshold throughout, but with a slight decrease in probabilities on 29 and 30 May due to the risk of the onset of the high speed stream and also the natural electron decay from the radiation belts. MOSWOC REFM is forecasting a decline below Active during Day 2 (28 May), but this is considered to be too quick to reduce the fluence levels.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	80
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a decline in fluence. This is thought to be forecasting the decline too soon, with values more likely to remain above Active for longer.



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